CLAIMS

What is claimed is:

1. A resist composition, comprising a silicon-containing resist polymer.

2. The resist composition of claim 1, wherein the silicon-containing resist polymer has an oxygen reactive ion etch rate of not more than about 0.35 nm/s.

3. The resist composition of claim 1, wherein the silicon-containing resist polymer comprises between about 0.1 and about 40 percent by weight silicon.

4. The resist composition of claim 1, wherein the silicon-containing resist polymer comprises between about 1.8 and about 19.8 percent by weight silicon.

5. The resist composition of claim 1, wherein the silicon-containing resist polymer comprises isoprene.

6. The resist composition of claim 1, wherein the silicon-containing resist polymer comprises styrene.

7. The resist composition of claim 1, wherein the silicon-containing resist polymer comprises isoprene and styrene.

8. The resist composition of claim 1, wherein the silicon-containing resist polymer comprises silystyrene.

9. The resist composition of claim 1, wherein the silicon-containing resist polymer comprises vinylsilane.

10. The resist composition of claim 1, wherein the silicon-containing resist polymer comprises a polymer formed by a hydrosilylation of isoprene.

11. The resist composition of claim 10, wherein a hydrosilylation agent is selected from the group consisting of dimethylphenyl silane, triethylsilane, and dimethylethylsilane.

12. The resist composition of claim 1, wherein the silicon-containing resist polymer comprises poly(dimethylphenylvinylsilane-b-isoprene) having a molecular weight between about 17,800 and about 22,100.

13. The resist composition of claim 1, wherein the silicon-containing resist polymer comprises poly(trimethylsilylstyrene-b-isoprene) having a molecular weight between about 10,700 and about 28,700.

14. The resist composition of claim 1, wherein the silicon-containing resist polymer comprises poly(styrene-b-isoprene) having a molecular weight between about 5,500 and about 21,800.

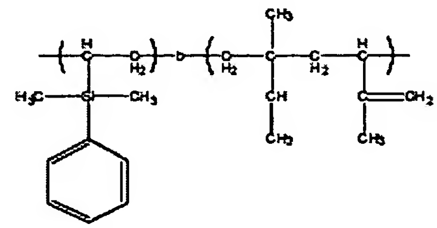
15. The resist composition of claim 5, wherein the silicon-containing resist polymer comprises poly(styrene-b-isoprene) having a molecular weight between about 5,500 and about 5,700.

16. The resist composition of claim 5, wherein the silicon-containing resist polymer comprises poly(styrene-b-isoprene) having a molecular weight between about 7,200 and about 21,800.

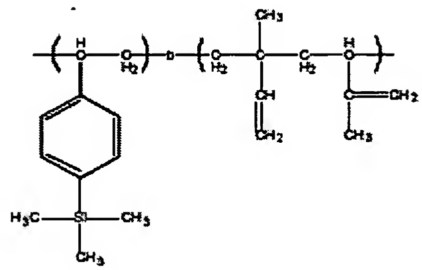
17. The resist composition of claim 1, wherein the silicon-containing resist polymer comprises poly(trimethysilylstyrene-co-chloromethylstyrene) having a molecular weight between about 10,000 and about 80,000.

18. The resist composition of claim 1, wherein the silicon-containing resist polymer comprises poly(pentamethydisilylstyrene-co-chloromethylstyrene) having a molecular weight between about 11,000 and about 100,000.

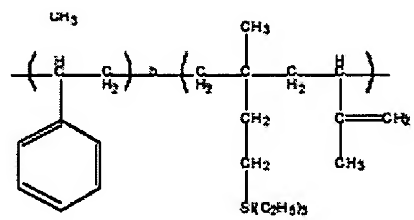
19. The resist composition of claim 1, wherein at least a portion of the silicon-containing resist polymer comprises a structure selected from the group consisting of:



,

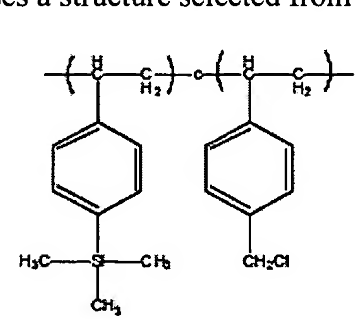


, and

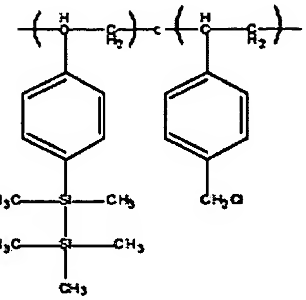


.

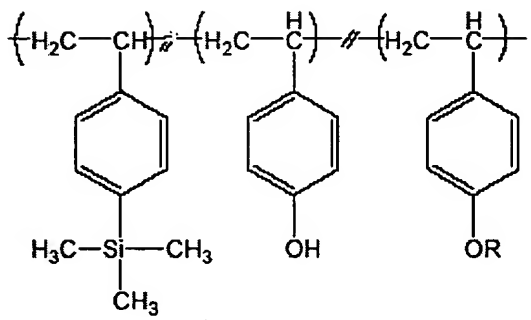
20. The resist composition of claim 1, wherein at least a portion of the silicon-containing resist polymer comprises a structure selected from the group consisting of



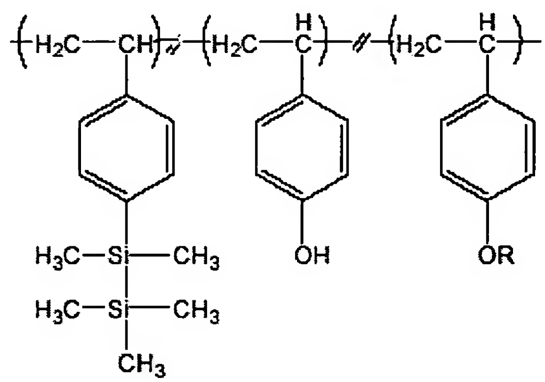
,



,



, and



,

wherein R represents a protecting group.

21. The resist composition of claim 20, wherein the protecting group R is selected from the group consisting of t-butyloxycarbonyl, trimethyl silane, and ethoxymethyl.

22. The resist composition of claim 1, wherein the resist composition contains not more than 14 percent by weight of oxygen and fluorine combined.

23. A resist composition, comprising a boron-containing polymer.

24. The resist composition of claim 23, wherein the boron-containing polymer comprises less than about 1 weight percent boron.

25. The resist composition of claim 23, wherein the boron-containing polymer comprises a boron concentration of up to about 2×10^{22} atoms per cubic centimeter.

26. The resist composition of claim 23, wherein the boron-containing polymer comprises carborane.

27. The resist composition of claim 23, wherein the boron-containing polymer comprises carborane carboxylic acid.

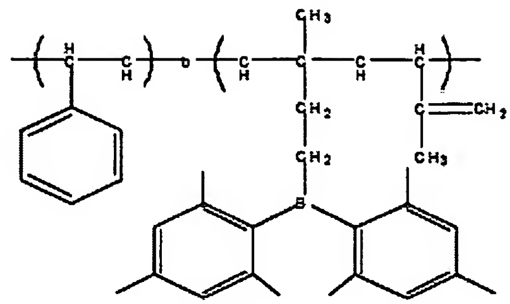
28. The resist composition of claim 23, wherein the boron-containing polymer comprises dimesitylborane.

29. The resist composition of claim 23, wherein the boron-containing polymer comprises isoprene.

30. The resist composition of claim 23, wherein the boron-containing polymer comprises styrene.

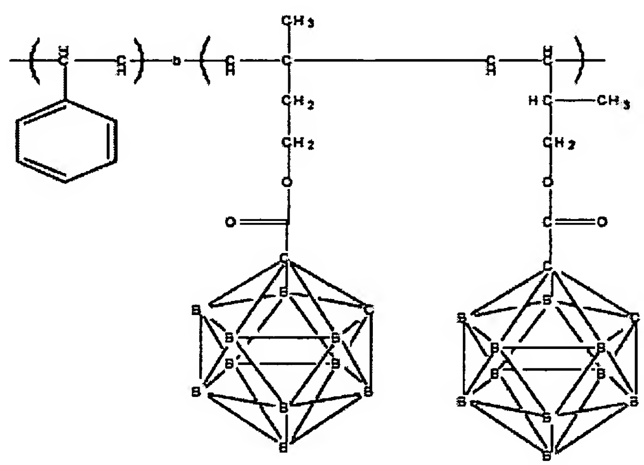
31. The resist composition of claim 23, wherein the boron-containing polymer comprises a vinyl group.

32. The resist composition of claim 23, wherein the boron-containing polymer comprises a polymer having the structure:

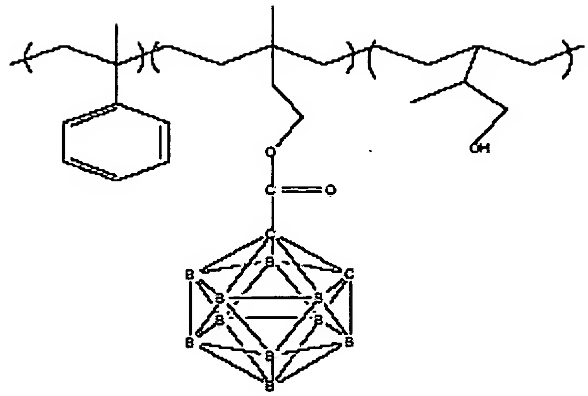


33. The resist composition of claim 32, wherein the resist composition comprises less than about 1 weight percent boron.

34. The resist composition of claim 23, wherein the boron-containing polymer comprises a polymer having the structure:



35. The resist composition of claim 23, wherein the boron-containing polymer comprises a boron-containing polymer having the structure:



36. The resist composition of claim 23, wherein the resist composition contains not more than 14 percent by weight of oxygen and fluorine combined.

37. A method for forming a silicon-containing resist copolymer, comprising: copolymerizing a monomer and a silicon-containing monomer to form the silicon-containing resist copolymer.

38. The method of claim 37, wherein the silicon-containing monomer is selected from the group consisting of silystyrene and vinylsilane.

39. The method of claim 37, wherein the monomer comprises a polymer selected from the group consisting of isoprene, styrene, and vinyl.

40. The method of claim 37, wherein the silicon-containing resist copolymer comprises between about 0.1 percent and about 40 percent by weight silicon.

41. A method for forming a silicon-containing resist composition, comprising hydrosilylating a resist polymer to incorporate silicon therein.

42. The method of claim 41, wherein the resist polymer comprises a polymer selected from the group consisting of isoprene, styrene, and vinyl.

43. The method of claim 41, wherein the silicon-containing resist composition comprises between about 9 percent and about 20 percent by weight silicon.

44. A method for forming a boron-containing resist polymer, comprising: performing a hydroboration or esterification reaction of a boron-containing group with a polymer.

45. The method of claim 44, wherein performing a hydroboration reaction of a boron-containing group with a polymer comprises performing a hydroboration reaction using dimesitylborane as a hydroboration agent to introduce dimesitylborane into the polymer.

46. The method of claim 44, wherein performing an esterification reaction of a boron-containing group with a polymer comprises performing an esterification reaction to introduce carborane into the polymer.

47. The method of claim 46, wherein the carborane comprises carborane carboxylic acid.

48. The method of claim 44, wherein the polymer comprises a polymer selected from the group consisting of isoprene, styrene, vinyl, poly(styrene-b-isoprene), hydroxylated poly(styrene-b-isoprene), poly(styrene-b-hydroxystyrene), and poly(α-methylstyrene-b-hydroxystyrene).

49. A method for increasing the reactive ion etch resistance of a polymer, comprising incorporating boron atoms into the polymer.

50. The method of claim 49, wherein the reactive ion etch resistance is the oxygen reactive ion etch resistance.

51. The method of claim 49, wherein incorporating boron atoms into the polymer comprises performing hydroboration of a polymer.

52. The method of claim 51, wherein the hydroboration agent comprises dimesitylborane.

53. The method of claim 49, wherein incorporating boron atoms into the polymer comprises performing an esterification reaction of the polymer and a carborane.

54. The method of claim 53, wherein the carborane comprises carborane 1-carboxyl chloride.

55. The method of claim 49, wherein the polymer comprises a polymer selected from the group consisting of isoprene, styrene, vinyl, poly(styrene-b-isoprene), and hydroxylated poly(styrene-b-isoprene), poly(styrene-b-hydroxystyrene), and poly(α-methylstyrene-b-hydroxystyrene).

56. The method of claim 49, wherein the boron atoms have a concentration in the polymer of up to 2×10^{22} atoms per cubic centimeter.

57. In a method of reactive ion etching a resist composition comprising a polymer, the improvement comprising including at least one element selected from the group consisting of boron and silicon in the polymer in an amount effective to decrease the reactive ion etch rate of the polymer.

58. The method of claim 57, wherein including at least one element selected from the group consisting of boron and silicon in the polymer comprises including at least a sufficient amount of the at least one element to decrease the oxygen reactive ion etch rate of the polymer.

59. In a method of making a feature on a substrate by: (a) coating said substrate with a resist composition comprising a polymer; (b) exposing the resist composition to extreme ultra-

violet radiation; and then (c) reactive ion etching said resist to form the feature thereon, the improvement comprising:

including at least one element selected from the group consisting of boron and silicon in said polymer, wherein said feature has at least one dimension less than 100 nm.

60. The method according to claim 59, wherein said resist composition is a composition comprising a silicon-containing polymer.

61. The method according to claim 59, wherein said resist composition is a composition comprising a boron-containing polymer.

62. The method according to claim 59, wherein said substrate is selected from the group consisting of semiconductor substrates, microelectronic device substrates, integrated circuit substrates, and nanoscale substrates.

63. The method according to claim 59, wherein said at least one dimension less than 100 nm comprises at least one dimension less than 75 nm.

64. The method according to claim 59, wherein said at least one dimension less than 100 nm comprises at least one dimension less than 50 nm.